

**REMARKS**

Claims 1 to 9 are in the application wherein claims 6 and 7 stand withdrawn from consideration by the Examiner as being for a non-elected invention; claims 1 to 5, 8 and 9 stand rejected under 35 U.S.C. §112, second paragraph, on grounds of indefiniteness; claims 1, 2, 8 and 9 stand rejected under 35 U.S.C. §102(b) as being anticipated by Fontein, et al.; and claims 3 to 5, 8 and 9 stand rejected under 35 U.S.C. §103(a) as being unpatentable over Fontein, et al.

The Office Action has been considered and, pursuant thereto, all of claims 1 to 9 have been amended hereof. The amendments to claims 1 to 5, 8 and 9 more clearly define Applicant's invention in a manner to correct defective language in the claims in order to overcome the rejection under 35 U.S.C. §112, second paragraph. Amendments are also made to claims 1 to 5, 8 and 9 in order to more clearly define Applicant's invention and to better distinguish it over the cited reference. Moreover, the specification, including the Abstract, has been comprehensively revised in order to eliminate the informal language defects and other defects identified in the Office Action, as well as to extend the use of idiomatic english in the description of the invention.

The claims, as amended, are directed to an improved form of micro-bubble generating system adopted to generate micro-bubbles having diameters of not more than 20  $\mu\text{m}$ , which diameter is significantly smaller than those of micro bubbles produced by apparatus heretofore known in the art. In order to accomplish the described improved operation the stream of swirling gas induced into the interior space of the container main unit is exposed to contact with swirling pressurized liquid which is supplied through an inlet which communicates tangentially with the aforementioned interior space and thereby contacts the gas stream to narrow it and tear it down. This feature, which is common to all of the claims in the application, is as contrasted with the apparatus and method of operation

U.S. Patent Application Serial No. 09/743,531

taught by the patent to Fontein, et al., wherein, instead of the pressurized liquid emerging from the tangential opening 2 being made to contact the gas stream flowing axially through the unit for narrowing it and tearing it down as in the claimed invention, the pressurized liquid is directed so as not to impinge upon the pipe (8 in Figure 1 or 9a in Figure 2) but, instead, to simply aspirate the gas which is to be dispersed in the liquid, as described at column 3, lines 38 to 41 of the patent. More specifically, as stated in the reference at column 3, lines 24 to 27, such aspiration is produced by the formation of a central hollow core filled with air or vapor created when the cyclonic liquid current is introduced into the rotation chamber 7 or 7a, etc.

For the foregoing reasons therefore, it is submitted that the claims, particularly as amended, define apparatus and method of operating the same which is clearly distinguishable from the apparatus and method described in the reference patent. The claims are therefore submitted as being patentable over the reference and consequently allowable.

Moreover, in view of claim 1, which is a generic claim, being now placed in an allowable condition, amendments are made hereof to the withdrawn claims, claims 6 and 7, wherein they are made to be depend from claim 1 so as to be allowable along with claims 1 to 5, 8 and 9, in accordance with the provisions 37 C.F.R. 1.141(a).

If, for any reason, it is believed that this application is not now in condition for allowance, the Examiner is requested to contact Applicant's undersigned attorney at the telephone number indicated below to arrange for an interview to expedite the disposition of this case.

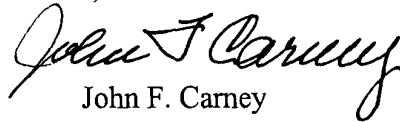
Attached hereto is a marked-up version of the changes made to the claims by the current amendment. The attached page is captioned "**Version with markings to show changes made.**"

U.S. Patent Application Serial No. 09/743,531

In the event that this paper is not timely filed, Applicant respectfully petitions for an appropriate extension of time. Please charge any fees for such an extension of time and any other fees which may be due with respect to this paper, to Deposit Account No. 01-2340.

Respectfully submitted,

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PATENT TRADEMARK OFFICE

Enclosures: Version with markings to show changes made  
Request for Approval of Drawing Corrections w/Figs marked in red ink  
Substitute Specification  
Substitute Abstract of the Disclosure

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**VERSION WITH MARKINGS TO SHOW CHANGES MADE 09/743,531**

**IN THE DRAWINGS:**

Figures 1(a) and 1(b) were corrected as shown in red ink on the attached One sheet of drawings.

**IN THE SPECIFICATION:**

The Specification was replaced with the attached Substitute Specification.

**IN THE CLAIMS:**

The claims were **AMENDED** as follows:

1. (Amended) A [swirling type] micro-bubble generating system, comprising a container main unit having [a cylindrical] an interior space closed by a [with] bottom at one end, a [pressure] pressurized liquid inlet [opened in tangential direction on a part of circumferential surface of inner wall of said] communicating tangentially with said interior space, a gas introducing hole [opened at] opening in the closed bottom of the [cylindrical] space and being operative to introduce gas into said space to generate a swirling gas that is exposed to contact with swirling pressurized liquid introduced through said pressurized liquid inlet, and a swirling gas-liquid mixture outlet [opened] opening at the [top] other end of said [cylindrical] interior space.

2. (Amended) A [swirling type] micro-bubble generating system, comprising a container main unit having [a] an interior [megaphone-like] space of frusto-conical shape and being closed at one end [with inlet closed], a [pressure] pressurized liquid inlet [opened in tangential direction on a part of circumferential surface of inner wall of said] communicating tangentially with said interior space, a gas introducing hole [opened on an] opening at one end of said [megaphone-like] frusto-conical space to generate a swirling gas that is exposed to contact with swirling pressurized liquid introduced through said liquid inlet, and a swirling gas-liquid mixture outlet opened at the [top] other end of said [megaphone-like] interior space.

3. (Amended) A [swirling type] micro-bubble generating system according to one of [claim] claims 1 or 2, wherein a plurality of [pressure] pressurized liquid inlets [opened] open in tangential direction on a part of a circumferential surface of an inner wall of the space are [provided with spacings on] spaced about the circumference of the inner wall of the interior space.

4. (Amended) A [swirling type] micro-bubble generating system according to one of claims [1 to 3] 1 or 2, wherein the [pressure] pressurized liquid introducing hole is opened on a part of the circumferential surface of inner wall near the [top of] gas-mixture outlet from said interior space.

5. (Amended) A [swirling type] micro-bubble generating system according to one of claims [1 to 4] 1 or 2, wherein the [pressure] pressurized liquid inlet is opened on a part of [circumferential] circumferential surface of inner wall near a middle portion of said interior space.

6. (Amended) A [swirling type] micro-bubble generating system according to one of claims [1 to 5] 1 or 2, wherein a baffle plate is arranged [immediately before] closely spaced from the swirling gas-liquid mixture outlet [opened at the top of] from the [cylindrical] interior space.

7. (Amended) A [swirling type] micro-bubble generating system according to one of claims [1 to 5] 1 or 2, wherein a partition plate for closing the outlet is attached, leaving only a partial opening[, immediately before] defining the swirling gas-liquid mixture outlet [opened at the top of] from the [cylindrical] interior space.

8. (Amended) A method for [swirling type] micro-bubble generation, using a micro-bubble generating system, which comprises a container main unit having [a cylindrical] an interior space with a bottom, a [pressure] pressurized liquid inlet opened in a tangential direction on a part of a circumferential surface of an inner wall of the space, a gas introducing hole opened at the bottom of the [cylindrical] interior space, and a swirling gas-liquid mixture outlet opened at [the top] a mixture discharge end of the [cylindrical] interior space, whereby said method comprises:

a first step of forming a swirling gas cavity for swirling and [quiding] guiding self-sucked gas while extending and narrowing down the gas flow in the [cylindrical] interior space; and

a second step of generating micro-bubbles by forcibly cutting off and smashing the swirling gas cavity by contact with swirling pressurized liquid due to a difference of swirling velocity between the gas and liquid portions in the swirling gas cavity.

9. (Amended) A method for [swirling type] micro-bubble generation, using a micro-bubble generating system, which comprises a container main unit having [a cylindrical] an interior space with a bottom, a [pressure] pressurized liquid inlet opened in a tangential direction on a part of a circumferential surface of an inner wall of the space, a gas introducing hole opened at the bottom of the [cylindrical] interior space, and a swirling gas-liquid mixture outlet opened at [the top] a mixture discharge end of the [cylindrical] interior space, whereby said method comprises:

a first step of forming a swirling gas cavity for swirling and [quiding] guiding self-sucked gas while extending and narrowing down the gas flow in the [cylindrical] interior space; and

a second step of generating micro-bubbles by forcibly cutting off and smashing the swirling gas cavity by contact with swirling pressurized liquid due to a difference of swirling velocity between the portions in the swirling gas cavity;

a third step of continuously cutting off and smashing the swirling gas cavity in said [cylindrical] interior space due to relative increase of the difference in rotating velocity between the rotating cut-off portion and smashing portion in the second step, the liquid passing through the rotating cut-off portion is rapidly expanded in conical shape while rotating (where the fluid

U.S. Patent Application Serial No. 09/743,531

not containing micro-bubbles is filled in the rotating fluid expanding in conical shape) the rotating fluid expanding in conical shape is stably formed, and expanding angle of conical shape is large (about  $90^\circ$ ), and rotating difference of rotating velocity is relatively increased between the rotating [cur-off] cut-off portion and the smashing portion in the second step.



**IN THE ABSTRACT**

The Abstract was **AMENDED** as follows:

**SUBSTITUTE ABSTRACT OF THE DISCLOSURE**

The swirling type micro-bubble generating system according to the present invention [comprises] possesses a container main unit having a cylindrical space with bottom or a [megaphone-like] frusto-conically shaped space, a liquid inlet provided in a tangential direction on a part of a circumferential surface of all inner wall of said space, a gas introducing hole provided on the bottom of said cylindrical space or opening of said [megaphone-like] frusto-conically shaped space, and a swirling gas-liquid mixture outlet arranged at [the top] opposite end of said cylindrical space or opening of said [megaphone-like] frusto-conically shaped space. According to this system, it is possible to readily generate micro-bubbles in an industrial scale, and the system is relatively small in size and has simple structure and can be easily manufactured. The system can be used in applications such as purification of water quality in ponds, lakes, marshes, man-made lakes, rivers, etc., for processing of polluted water using microorganisms, culture of fishes and other aquatic animals, and increase of oxygen and dissolved oxygen in culture solution in hydroponics culture farm and improvement of production yield.